

Introduction

- Epidural analgesia has emerged as the gold standard for delivery of labour analgesia. The methods for delivery of anaesthetic solution have evolved over time, with many institutions using Programmed Intermittent Epidural Bolus (PIEB) regimens. One of the proposed explanations for better analgesic outcomes when using PIEB regimens compared with continuous epidural infusion (CEI) regimens is the better spread of anaesthetic solution caused by higher peak injection pressures.
- Increased distal driving pressure is proposed as a reason for improved efficacy and better spread of anesthetic solution with PIEB. This study measured the distal pressure with variation in the proximal driving pressure generated via epidural pump or syringe.

Methods

Study design: Prospective in-vitro laboratory study on non-living matters

Dataset: *Distal epidural pressure generation using both syringe and epidural pump.*

Methods: We evaluated closed-end multiport and open-end uniport (19Ga 90cm FlexTip Plus® Arrow) catheters. Distal pressure measurement apparatus was made up of a three-way tap attached to a digital manometer, a low resistance saline filled syringe to imitate the potential epidural space, and a SnapLock device that connected the catheter (Figure 1).

Pressure was generated using the CADD epidural pump for PIEB 10 ml, patient controlled epidural analgesia (PCEA) 5 ml, and continuous epidural infusion (CEI) 8 ml/hr of normal saline. Positive and negative pressures were also evaluated using 3 ml, 10 ml, and 20 ml syringes by injection and aspiration of normal saline, respectively. Each experiment was repeated three times.

We measured distal pressure generated from each mode of delivery with variation of the epidural catheter/ filter assembly system and syringe size.

The following sets of data were obtained from each experimental variation:

1. *Distal vs. proximal pressure with PIEB, PCEA and CEI in multiport catheters*
2. *Single vs. multiport catheters (filter in-situ)*
3. *Multiport catheter, filter vs. no filter*
4. *Syringe flush (filter vs. no filter)*
5. *Aspiration via syringe (slow vs. fast)*

- **The primary outcome was peak pressure generated from each mode of pressure delivery.**
- The data are reported as mean (Standard deviation) and t-tests were done for group comparisons. P-value <0.05 was considered statistically significant..

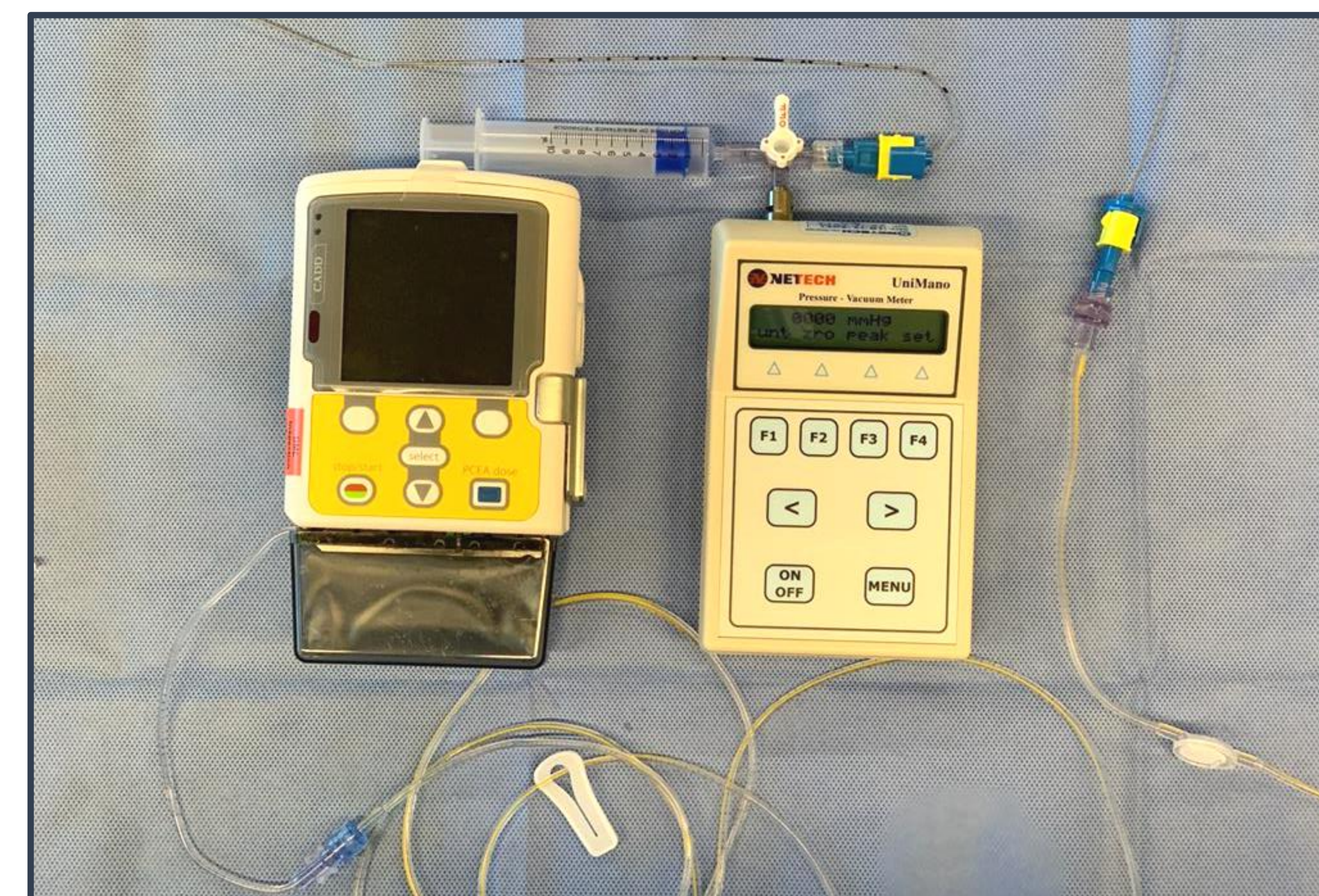
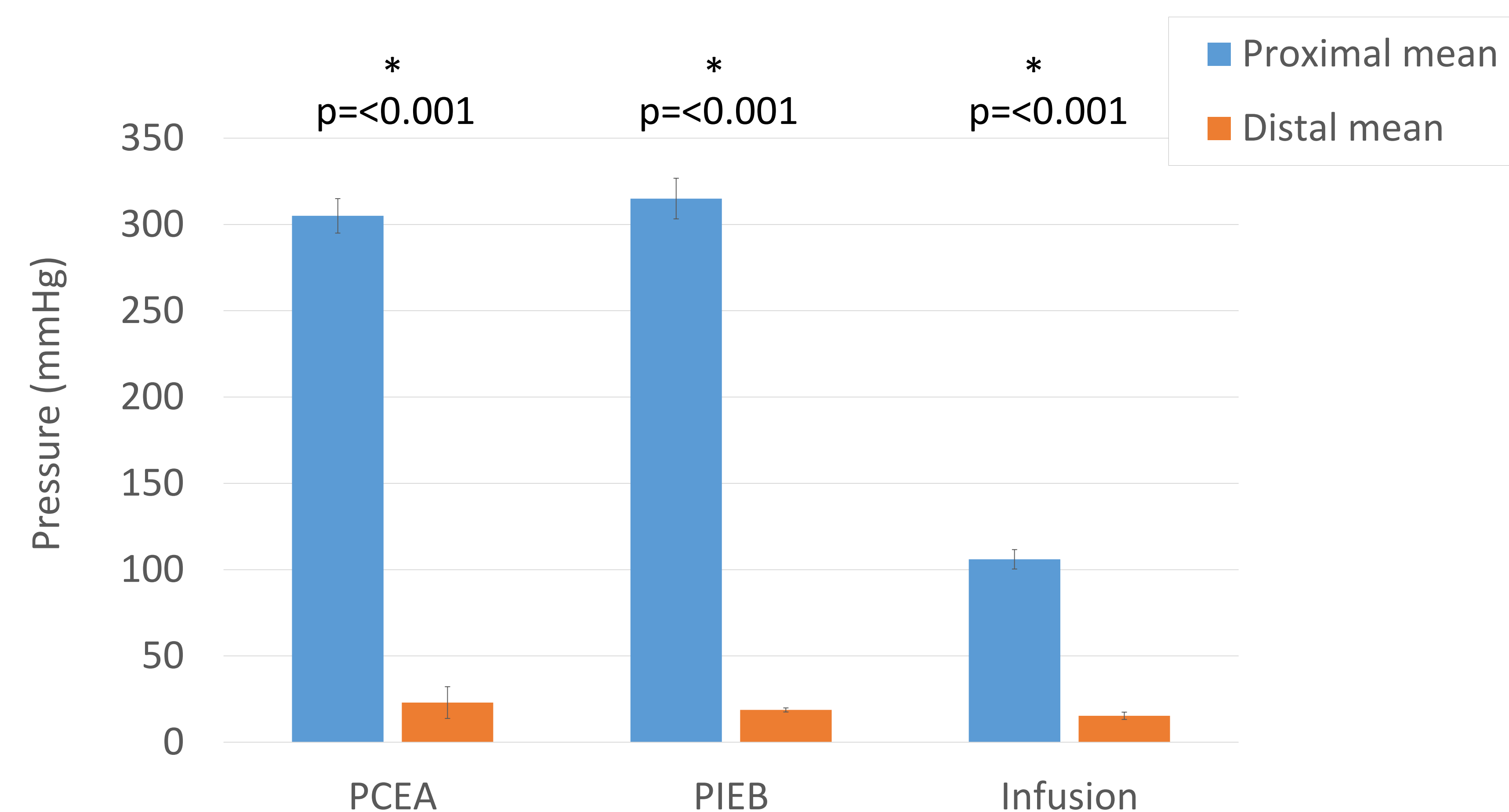


Figure 1: Distal pressure measurement

Results

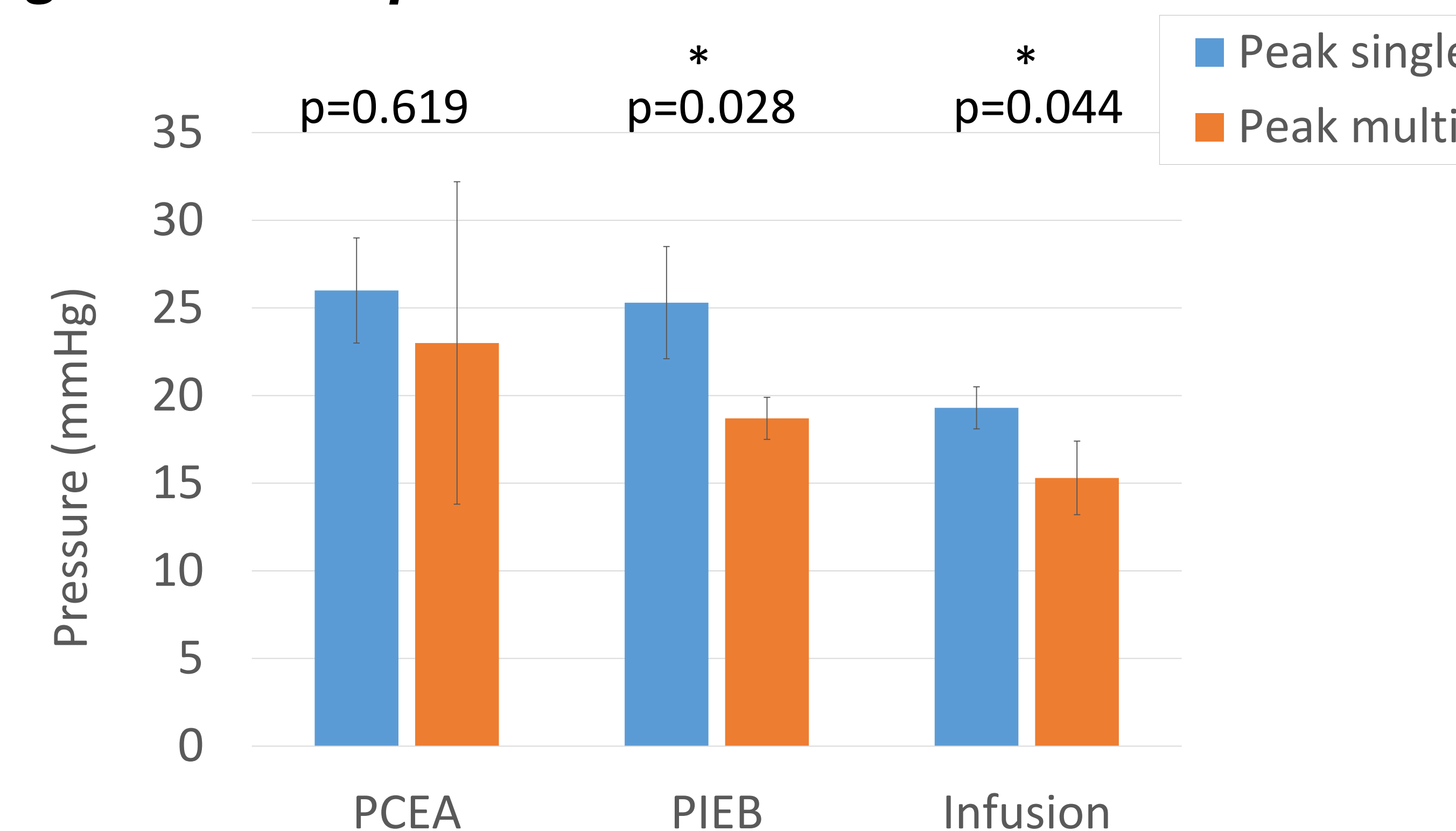
- 108 experiments were undertaken. Peak pressure generated via epidural catheter with each modality and with various volumes of syringes is shown in Figures 1-6.

1. Distal vs. proximal pressure generation



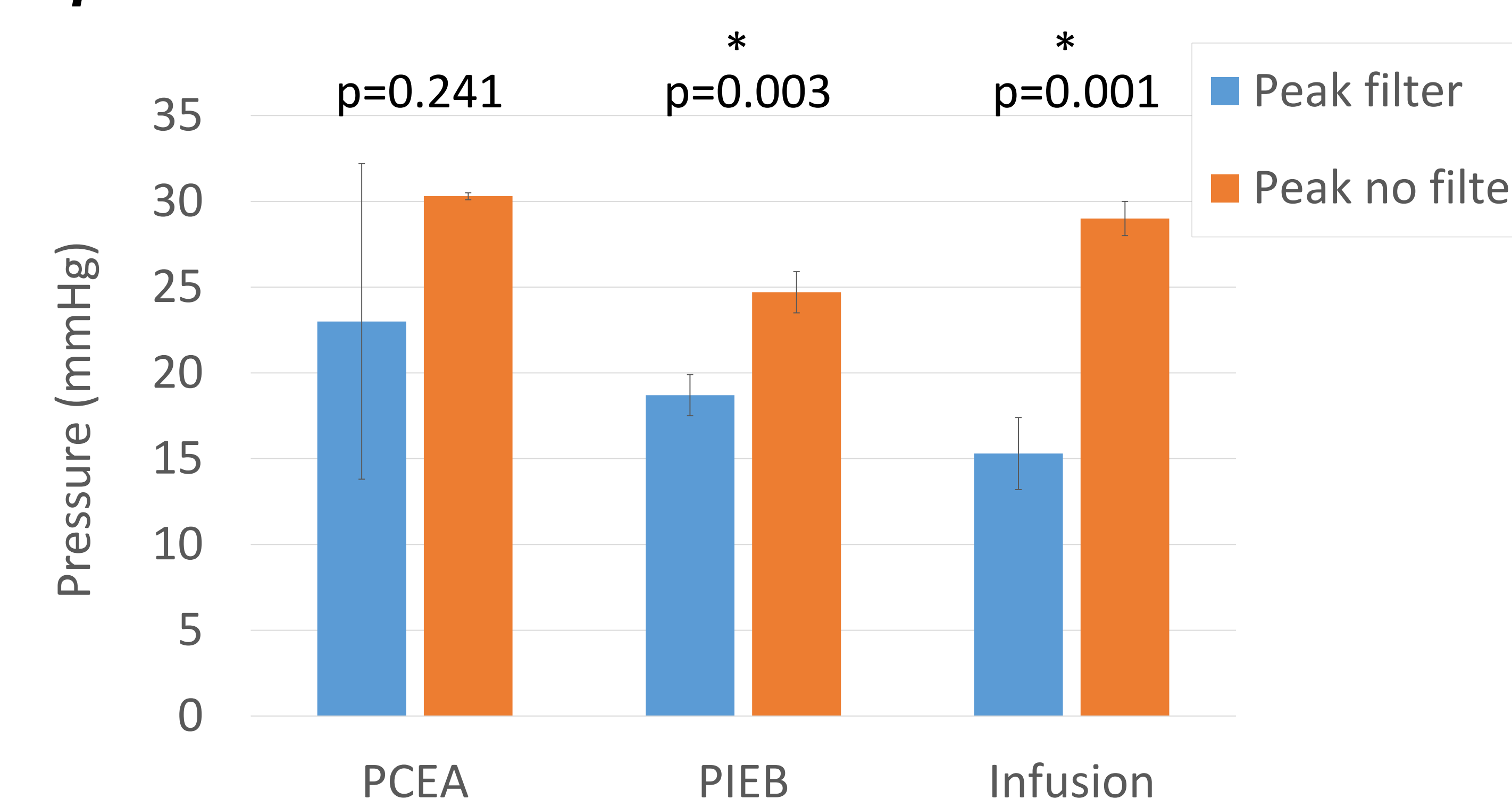
When tested with PIEB, PCEA and CEI in a flushed multiport catheter system with filter in-situ, the pressure generated at the distal end of the catheter was significantly lower for all 3 modalities when compared with the pressure at the proximal end.

2. Single vs. multiport catheter



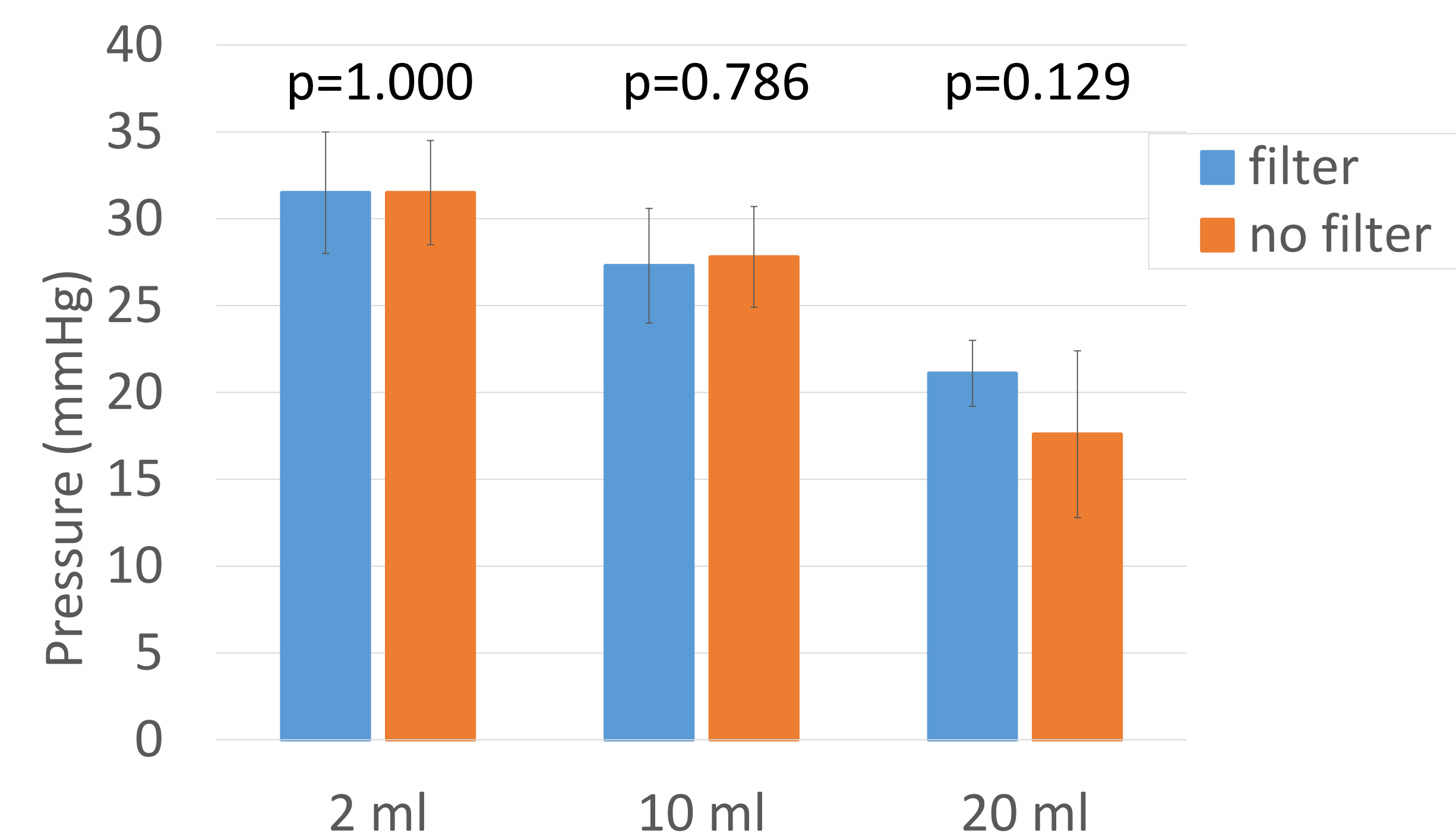
Pressure generated at the distal end of a single port catheter was higher than the multiport catheter, however the difference was significant for PIEB and epidural infusion mode only.

3. Multiport catheter with filter in-situ vs. no filter



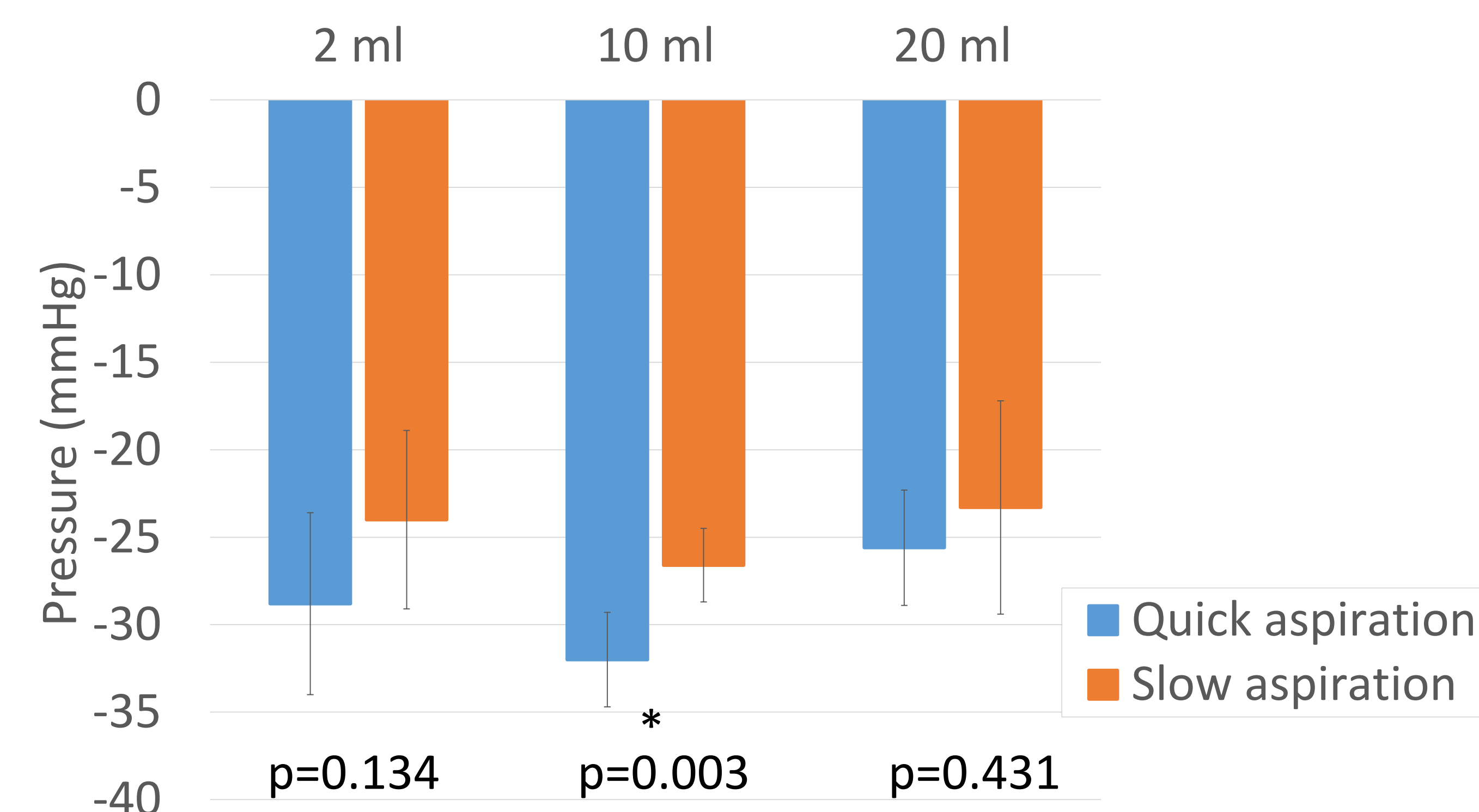
Presence of a filter in the system caused a statistically significant reduction in the distal pressure generated for PIEB and epidural infusion.

4. Syringe flush (filter vs. no filter)



Flushing the epidural catheter system with a syringe attached to a filter produced no discernible difference in the pressure generated at the distal end of the catheter when no filter was attached.

5. Aspiration via syringe (slow vs fast)



Fast and forceful manual aspiration using a syringe generated higher peak negative pressure compared to slow aspiration, however, the difference was significant for 10 ml syringe only.

Discussion

- Several aspects were associated with higher distal peak pressure generation, including the presence of the epidural filter and the use of single orifice catheters.
- There was approximately 10-fold reduction in distal pressure when compared with the pressure measured at the proximal end of epidural catheter in a multiport catheter. This shows a significant step down dampening effect of the catheter from the proximal to the distal end.
- Manual injection produces similar pressures during injection with or without the presence of a filter, however forceful aspiration produces remarkable negative pressure with a 10 ml syringe.
- It is clear that, while the step down of pressure from proximal to distal end of the catheter is marked, the changes in equipment and method for applying pressure have a potential to modify the overall delivered pressure.

References

- Wong C et al. A Randomized Comparison of Programmed Intermittent Epidural Bolus with Continuous Epidural Infusion for Labor Analgesia. *Anesthesia & Analgesia* 2006;102:904-9
- Stirparo S et al. An in Vitro Evaluation of Pressure Generated by Programmed Intermittent Epidural Bolus (PIEB) or Continuous Epidural Infusion (CEI). *Open Journal of Anesthesiology* 2013;3:214-7